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AUTHOR Brown, George D., Jr.; Ladd, George T.
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INSTITUTION Boston Coll., Chestnut Hill, Mass. Dept. of Geology and Geophysics.
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ABSTRACT

To achieve economy in the teaching of earth sciences, an audiovisual-tutorial program was designed in the pattern of a simulated field trip. Twelve weekly exercises combining slides, filmstrips, and audiotapes were produced and tested on an experimental group of 50 students, who also received one lecture a week. The program was evaluated and revised weekly, with the number of lectures increased to two by student demand. After one semester, student test scores were compared to those of students taught by conventional methods, and there were no differences. The method has now been extended to other courses. (SK)

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EXCURSIONS IN GEOLOGY

George D. Brown, Jr. and George T. Ladd

Boston College

Chestnut Hill, Mass. 02167

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As academicians we are faced with the responsibility of ensuring that our students receive the best possible training that we can offer. This includes the formal training in subject matter, and also the informal aspects. As academicians we are also confronted with administrative matters within our departments and these involve decisions that may detract from our prime mission. For example, the senior author, as a science department chairman, is charged by his University with effecting economical operations wherever possible. Simultaneously, he is charged with providing the best possible education. Often, these two goals contradict each other.

The junior author, as director of science education programs, in another college of our university, is charged with designing and implementing programs for students so that they can receive a blend of both science and education courses within the limited framework of time and course loads. Obviously, the prime goals of education must be met <u>within</u> the context of a <u>real</u> rather than an <u>ideal</u> university

Our university is not particularly different from many of your own schools. We face typical academic and other problems. There is a shortage of available space for too many students, not enough equipment, shortages of personnel, and other problems. Then, too, there is the cost involved in university operations today.

One of our more foresighted acts was the hiring of the junior author, a specialist in earth science education whose services we shared with the college of education in our university. Such an act is rather uncommon in a hard-core science. The advantages of such a staff member, however, should be obvious to any administrator.

Any new approach in a hard core science is difficult to engineer. The very nature of a science discipline tends to resist innovation because it challenges "tried and true" methods. And yet, many approaches provided by professional educators tend to more innovative and open than those provided by scientists because the former is less concerned with the details of the discipline and more concerned with how to communicate it to the student. And so it was with us. We had been introduced previously to the EARTH SCIENCE CURRICULUM PROJECT,

an inovative program intended to improve the teaching of earth science subjects at the secondary level. When the junior author was hired, we were ripe for any new ideas.

Fresh out of graduate school, he brought some of the latest ideas in innovative approaches to education. Further, he had very wide contact with other earth science teachers across the country. The result was that he made honest teachers of us in the same sense that we were forced to examine the methods of teaching that we were using. It was apparent that we were deeply committed to our discipline, but we were forced to ask if our students were as deeply committed.

It is always a great shock to have someone question your teaching methods. It is an even greater shock to finally admit that perhaps the teaching method could be improved.

At the time of our soul-searching we had just faced a student crisis that questioned sharply rising tuitions and other costs. We were forced to evaluate our departmental operation, especially methods and goals, so that we might be able to solve as many of the educational problems as possible within the framework of our university structure. And that word structure really should be pronounced as finances, space, and personnel.

Our science educator suggested an AUDIO-VISUAL TUTORIAL format for our introductory courses, those that enrolled the most students and required a major portion of our operation. Like many teachers, we questioned the format suggested, but we were quick to realize the potential of such an approach.

Many questions immediately appeared....would the students receive as good an education in a new format? Could we provide any individualism within the A-T format? How would the students receive such a format?

These questions were difficult enough. But even more difficult was where to find such a program in geology. None were in existence. If we wanted one, it would have to be written.

Let me outline our previous program in introductory geology for you so that you may understand our problem. These were typical science

courses for non-science majors and they were taken to fulfill university requirements as part of an optional sequence. Each course consisted of three one-hour lectures and a two-hour laboratory session each week. Approximately 300 students enrolled in these semester courses, but attendance was sporadic; perhaps 65% attendance was typical unless some outside activity was available, then the attendance would drop even lower. We realized that the students had changed over the years though we had remained the same. Students had become more sophisticated because of advances in the courses and methods in secondary schools. They asked new kinds of questions. They demanded more for their money.

We thought that an A-T format would be a natural one for our program. There were many discussions regarding the particular details before we decided to implement such a format. We believed that we could maintain the same enrollment levels without sacrificing course content; this would please the professional scientists on our staff. At the same time, we discovered that an A-T format would actually permit increased enrollments; this would satisfy the goals of the university in maintaining high student-faculty rations. Thus, we could achieve fiscal responsibility, and perhaps show the students, faculty, and university a new way of learning.

Our program sought a break from the previous system, but we needed a focal point. Our lectures were not particularly a problem, but our laboratories were in serious trouble. A traditional laboratory session might involve having the students examine minerals for the entire period. The study was boring, irrelevant, and mechanical. Students learned their minerals, but to what purpose. The best place to reform our program was, therefore, in the laboratories. But, how???

Geologists have always been interested in field work. After all, the science developed in the field or the outdoors, and that is where it still exists. Years ago, academicians moved their classes and laboratories indoors because of the convenience....but the real world of geology was still outdoors. We have always been committed to field work for our students, especially a lengthy field trip to

some area as part of a semester course work. This past May we led a group of 25 to Iceland for a two-week stay. The suggestion was made to use a field trip approach to geology for the A-T format. This could provide an acceptable substitute for an actual field trip. We obviously couldn't take all our students on trips.

That was it, then, a SIMULATED FIELD TRIP to all the best places in the world to study actual samples via color slides and audio tapes. Slides could be gathered from our own collections, borrowed, or purchased. And we could also produce the audio tapes.

We had many discussions with various people, viewed many films, and sought ideas from everywhere. None seemed to fit our needs as we viewed them. All too often, existing films were nothing but the teacher presenting his or her lectures on films. To us, that seemed inappropriate because it removed the human element which we desired.

We decided to design simulated field trips in which the lecturer heard on the tapes would take the individual student with him on field trips. At various places along the way, the student would be told to look at slide such and such. There the student would view some particular feature. The tape voice would point out some aspects, perhaps ask a leading question, then go on to the next slide. It was immaterial that the next slide would be of a feature in Iceland or Hawaii, we were equipped with instantaneous travel capability, and the students quickly learned to accept these rapid shifts from place to place.

The lecture sections would be used to build upon the basic knowledge provided in these simulated field trips. And we added a one-hour seminar to ensure that students had ample opportunity to consult with faculty and staff.

The format was designed to consist of 12 weekly exercises that the students could take at their own pace, repeating portions if they were confused or consulting with the laboratory instructor. Goals were designed sufficiently broad that the students could achieve them with reasonable application. One lecture per week was thought adequate.

Obviously, we did not know whether the program would be successfully received, and whether it would satisfy the demands of the students, the faculty, and the university. Until we actually experienced it we could not hope to be able to judge the program. Accordingly, we decided to offer it to a small group of 50 students selected at random from volunteers in the large lecture sections. The program was written, edited, and rewritten, and produced, however inexpertly and poorly. Fortunately for us, it was judged a success by the students who participated.

We immediately set about finding out what we did right and what we did wrong, and there was enough of both to go around. Students were quizzed weekly on their view of the program, its weak points and its assets. They overwhelmingly advocated increasing the number of lectures from one to two. That was the first time I ever heard students asking for more lectures. Usually it was the other way around.

Our teaching assistants were also quizzed as to good and bad points, and they pointed out some aspects that we improved and others that we emphasized.

Finally, we made the supreme test. At the end of the semester we gave the same examination to the small test group that we gave to the large, traditional sections. Fortunately, there were no differences in the result.

We also quizzed the test group students on their view of science. The answers indicated that we could have ignored all doubts we had earlier. They were actually enthusiastic, and we found that many of them enrolled in advanced courses in the department, something we had rarely experienced from non-science majors.

Today our program consists of two separate semester courses, one in Physical Geology and the other in the companion course, Historical Geology. We are in the early stages of developing an A-T program in our Introductory Oceanography course, and will modify our courses in Introductory Meteorology and Introductory Astronomy.

The one lecture format has been replaced by two lectures per week. The laboratory session takes the students to various parts of the world, and primarily the United States to study such diverse topics as Volcanoes, Ocean Shorelines, and Deserts. Instead of having them

learn a collection of the most common minerals in a sterile environment without reference to the origin and significance of these minerals, they now learn what minerals are naturally a part of Volcanism. They also learn where the volcanoes occur and why. They see their different forms, how they weather and are eroded, and what evidences we have of them in the geologic record. In many cases, we provide simple experiments and demonstrations to assist them to learn about the topics under study. When they have finished an exercise, they take a self-checked quiz, then compare their answers with some that we provide. In this manner, they are the keepers of their progress. If their answers indicate they didn't understand some aspect, they are free to return to any segment of the program and retake it. They may also quiz the laboratory instructor who is present at all times. Or, they may bring problems to the seminars.

The 12 exercises that we have prepared form the tree trunk of our program. We plan to add branch exercises to the trunk each year until we have developed a full size tree. Then, when we add enough branches, we will provide a truly open program in which the student can plan his or her directions according to interest. We will serve in an advisory capacity whenever possible.

Recently we attempted to judge our program after three years of full operation. We asked students to fill out a lengthy questionnaire on faculty, laboratory assistants, examinations, course content, and more. The results showed no real changes from the data provided us by the students in the test program. We feel that the program is successful and that the students have gained.

The combination of a professional geologist and a professional educator was an optimum blend because it provided the necessary tools and expertise to develop the courses. One provided the scientific know-how to recommend what materials should be included, what goals were to be achieved, and where the material could be obtained for inclusion. The other showed how to combine these into an educationally sound package. And he developed a critical questioning technique that sought out the weak points.